

# EXPLORATION AND PRACTICE OF SCHOOL-ENTERPRISE COOPERATION IN PRACTICAL EDUCATION BASED ON “OUTSTANDING PROJECT”

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**Abstract:** There will be difficulties in moving forward the project for educating and cultivating outstanding engineers, therefore, based on the outstanding project, it's crucial to come up with an efficient method to deal with the issues in the practice of school-enterprise cooperation engineering. This thesis is going to deliver the discussions in the following aspects: a. The forms and contents of how to build the school-enterprise cooperation practice; How do we conduct engineering practice; c. How do we make sure enough teachers and working places for engineering practice are provided; d. How do we guarantee the quality of engineering practice and build its related valuation system.

**Key words:** outstanding project, school - enterprise cooperation, Innovative Research, the ability to conduct engineering practice.

## 1. INTRODUCTION

The project for educating and cultivating outstanding engineers (simplified as outstanding project below) aims to create and nurture a group of highly qualified engineering technicians of all kinds, who are more than capable of innovating and

adapting to the development of economical society, to pave the way for China to become an industrially innovation-oriented country and serve for the strategy to strengthen the country with talents. Our Department of Progress Equipment and Control Engineering which has been a part of outstanding project, where the students from the outstanding class have been enthusiastically invested, has received a general confirmation since 2011. As to overcome the difficulties to get through the period where the students are to graduate and busy with their engineering practice, it's necessary for schools and enterprises to cooperate for the education and nurture of the students, and as to achieve that goal, by learning from the experience of the advanced engineering education of CPIO and developed countries, we act a 3+1 talents-nurturing mode upon the outstanding class, in another word, the students will be studying on campus for 3 years then accumulating experience by working in enterprises as interns for another year. At the same time, they will be deeply and thoroughly involved in the practice in oil and

natural gas industries, which mainly contributes to forming the students' ability for engineering practice, modeling, and improving their professional morality and ethics. Thus, as to achieve the original goals of the outstanding project as expected, it is important for us to figure out how a team full of teachers with rich experience in engineer practice should be built, how we guarantee enough working places and time are provided, how we make sure the engineering practice effectively and efficiently happens as well as how the students can gain as much experience of design-practice as they can during the engineering practice.

## **1. PROBLEMS EXISTING IN SCHOOL-ENTERPRISE COOPERATION**

At present, many colleges and universities recruit students as teachers the same year they graduate and for those doctoral graduate students; they put a limit on the age of 33. These teachers learn while teaching at the same time to compensate for the fact that they are young and equipped with solid book knowledge, but lack of actual experience in engineering practice, which does not provide with the ability to well combine the book knowledge with the actual practice and receives bad feedbacks from the students. If the teachers don't have enough experience, it would definitely interfere with the cultivating of the outstanding engineers; on the other hand, however, the engineering technicians in enterprises, with their rich experience and extraordinary ability to analyze and solve problems in actual practice, play an important role in teaching and helping develop the students' ability in engineering practice, but it doesn't mean they are able

to well combine the book knowledge and engineering practice, which means it's necessary to have them trained and prepared. Besides, the students are required to have a full year of experience in engineering practice by the 3+1 program to gain more and higher ability to fit in the outstanding project. It's crucial to well communicate with the enterprises where the students do their internships to make sure the workplaces are provided by them.

## **2. APPROACHES AND METHODS FOR SCHOOL-ENTERPRISES COOPERATION TO CULTIVATE OUTSTANDING ENGINEERS**

### **2.1. Forms and contents of building school-enterprise cooperation practice based on the outstanding project**

Based on the theory, concept and practicing mode of modern advanced engineering education, accordingly build the 3+1 project, which is, in the 4-year period of college/university, the students are required to study on campus for 3 years while working in enterprises for another year in order to accumulate experience in design-implement by working shifts in individual segments in concentrated time. However, it does not mean the students can fully understand the whole process of design-implement with one single experience, that is why in the 4 years of college the teachers should arrange a series of activities where the students can experience the design-implement process and merge the experience into the course of outstanding project. In the early stage, the course of practice is bringing in some basic concepts and methods, but as the students experience accumulates, it gets more complex; as

a result, the students are required to go through and combine what they have learned as to enhance their practicing ability of design-implement.

In their first year, the students mainly focus on understanding the basic principles of the design process as well as how to select its concepts and use them in practice. For instance, the students make up of a team of five people and learn to build simple models for the clients as requested and experience the whole process of design and test, which helps improve their practicing ability and creativity and provides them with the opportunity to practice their ability of interpersonal communication and working as a team. In their sophomore year, the students will gather and combine what they have learned from difference courses to form a multi-course design. While in the meantime, they need to do text reports, which contain the purposes, updates, and thoughts of this design and discuss them. In the example of how to do a flexible design of pipelines in a restricted space, each team needs to sketch their design and illustrates how they design it, furthermore, they need to calculate the maximum displacement the pipes could handle in 3 dimensions and explain with what methods they calculated it; at last, they need to compare the theoretical value with the practical results and discuss the differences between them and come up with a way to improve their design, at the same time, the teachers will appraise the design based on its quality, the students' innovation as well as co-operation spirit and communication within the team and write them down in the record. In their junior and senior year, the students are going to take on more complex assignments. For example, in order to accomplish the goal of conserving energy and reducing emission to maintain a green

and low-carbon environment as requested in China's 12<sup>th</sup> 5-year plan, the students are asked to redesign the present industrial products by enhancing their performance, reducing the discharge of CO<sub>2</sub> and other harmful gases or cutting the cost of the materials, and give thorough consideration to multiple targets and weigh the advantages and disadvantages. Accordingly, the students need to use the plan that fits the practical situation the most and choose appropriate models and simulations based on the development to pick up the speed of the completely engineering practice. Finally, the senior students are to expand the range of design-implement in their graduation design, such as bringing in the targets needed in the business development, the students can make up of a team of 8-10 people, with students from outside outstanding class, and maintain an organized management and keep updates on the development of the design to make sure the design succeeds and eventually launch a functional experimental product.

## **2.2. Build a team of teachers with double skills based on the school-enterprise co-operation**

A team of teachers with engineering practice ability in advanced engineering education is needed as to successfully operate the outstanding project, at the same time, build a team of teachers who are experienced in both teaching and engineering practice, as known as "teachers with double skills", based on the school-enterprise cooperation and the principle of "going out and inviting in". Usually, there are only a few teachers in an engineering institute/department with the experience in designing and developing complex engineering systems, however, there are an abun-

dance of design-implement projects needing to be done by teachers with great ability and talents, that's why it's important to "go out", which means sending over teachers of related majors to work in the production run and engineering design departments of enterprises in the aim of accumulating experience in design - implement. The "going - out" project usually takes a period of 1-2 years which is relatively a long time, thus, after communicating and discussing with the enterprises to gain the access to involvement in the technology reformation or the design and launch of new products, the teachers get to temper their spirit of teamwork and improve their overall ability of engineering practice and designing in order to independently help the students through the process of design-implement; as contrary, to "invite in" is to employ technicians and staff who are highly experienced in engineering practice and management as teachers to take on assignments like teaching professional courses, addressing speeches of related technology, guiding students in their internships in enterprises as well as directing and coaching the students to finish their graduation designs. In addition, establish long-term systems where school provides the technicians the opportunity to study again and where enterprises help cultivate teachers of engineering for school so that the team of double-skilled teachers get to develop continuously. However, it takes a lot more than rich engineering practice experience to make an excellent and qualified engineering teacher, which makes further training like integrating book knowledge into engineering practice as well as improving the teachers' teaching skills a crucial step, hence, it's necessary for senior teachers highly experienced in teaching to train the

"invite-in" technicians before they get down to business.

### **2.3. Enough working places for engineering practice must be provided for the students**

To provide enough working places where the students get to work and gain experience in engineering practice is the basic condition for successfully operating the outstanding project. What is a workplace for engineering practice? It is a facility, which creates a working environment consisting of suitable working space and equipment. Workplace supports and encourages the students to learn and participate in the construction of products, processes and systems in engineering; on the other hand, it helps the students more easily understand and absorb the book knowledge and gain social practice experience. There are two ways to design a workplace, which are:

1. We can establish one or more workplaces by communicating and discussing with related enterprises, in their subordinate production and research department. For instance, the Process Equipment and Control Engineering major of our school (Northeastern Petroleum University, which locates in the city of Daqing, heilongjiang Province, China) has signed on the practice base agreement and the intent letter on joint training of talents with multiple corporations and companies, such as Daqing Oilfield Co., Ltd, Daqing Petroleum and Chemical Corporation, Daqing Refining & Chemical Company, Daqing Natural Gas Company and Construction Group and Petroleum & Petrochemical Equipment factory of Daqing Oilfield, which applies for concentrated engineering practice;

2. Take advantage of the "Invite-in"

mode and bring the small-scale equipment, devices, and machines from the enterprises into school's practicing places or a lab, which does not take up too much space and is easy for the students to practice in turns in separate segments.

Make the most of the geographic advantages of large-scale oilfields and petrochemical enterprises in Daqing and use the matters, like how the enterprises handle their technical problems and the re-learning of their technicians, as well as the enterprises' social publicity as the breakthrough to motivate the enterprises to be actively involved in cultivating the talents and strengthen their social responsibility. As a result, it helps the enterprises transform from an employing unit to a joint-training unit for talents. As for the students, they will not only gain engineering practice experience, but also get to immerse themselves in the enterprises' culture and develop their professional ethics in advance, on the other hand, school achieves their goals to make the talents cultivating plan of petrochemical and mechanical outstanding engineers and cultivate outstanding engineers, furthermore, the school manages to accomplish multi-win cooperation.

#### **2.4. Establish the security and evaluation system of engineering practice**

Engineering practice aims to help the students gain the design-implement experience, which makes it necessary to establish the system to secure and evaluate engineering practice. The system includes the establishment of the system to evaluate how well the students do in engineering practice as well as the establishment of the professional evaluation system of outstanding project.

College students' security and evaluation system of engineering practice should focus on collecting proof of their personal performance, interpersonal skills, ability to work as a team, capability of engineering practice and constructing the products as well as how well the students grasp their professional knowledge. The evaluation of students' engineering practice consists of four stages:

1. The standardization of engineering practice results;
2. The harmony between the evaluation and the practice results as well as teaching methods;
3. Use multiple ways to collect proof of the students' practice;
4. Use the evaluation results to improve the practice methods and evaluation system. Approaches to evaluate are: evaluate by taking written or oral tests; evaluate based on the students' performance in engineering practice; review the products and assignments; evaluate according to the students' practice learning log; students' self-evaluation.

The outstanding project will be incomplete with the internal students' evaluation system solely, that's why it needs an evaluation system for the project itself, which includes the methods used to evaluate and improve the evaluation, files reviews, interviews, surveys, teachers' practice experiences memorandum and the reviews from professors of inside and outside the school. The review contents are:

1. All the recorded documents on the engineering practice of outstanding project;
2. The engineering practice experience in design-implement;
3. Working places for engineering practice;
4. The examinations of engineering

practice;

5. The teachers' capability of engineering practice and its improvement;

6. The professional evaluation on engineering practice. The review system of inside-and-outside-school professors effectively guarantees the operation of outstanding project.

### 3. CONCLUSION

School and enterprises working together to cultivate outstanding engineers is a big and great event to spread and enhance China's mid/long-term educational reformation and development plans. The launch of the outstanding project is a graduating process where it takes constant and continuous search and correction to complete itself step-by-step. Our school takes advantage of the geographic and petrol characteristics and accordingly establishes forms and concepts of the school-enterprise cooperation, at the same time, with the principle of "going out, inviting in", we make sure the operation of outstanding project as well as the construction of major-matching teachers. In addition, the design-implement experience is separately and gradually gained in the 4-year period of school, which prepares and equips the students with certain capability to innovate and solve practical engineering problems, which contributes to benefiting all 3 parties of the students, enterprises and school; at the same time, it offers the opportunity where other schools in the operation of outstanding project can learn from our experience.

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